OPERATING INSTRUCTIONS

G-5/4

G-5/4

TYPE 1264-A

MODULATING POWER SUPPLY

GENERAL RADIO COMPANY

A

SPECIFICATIONS

Regulated Dc Output (Unmodulated)

Voltage: Adjustable from 200 to 300 volts.

Current: 50 ma maximum.

Stability: Output voltage at any rated load will change less than 0.5 volt for ±10% line-voltage change.

Ripple: Less than 1 mv rms with B- grounded; less than 5 mv rms with B+ grounded.

Heater Power Output (Unregulated)

Voltage: 6.3 volts ac.

Current: 2.1 amp maximum.

Square-Wave Output (Internally Generated)

Amplitude: Adjustable from approximately 160 to 210 volts.

Frequency: Adjustable from 850 to 1150 cps.

Stability: Frequency will change less than 0.5% for ±10% line-voltage change.

Duty Ratio: 0.5, adjustable ±5%.

Square-Wave Output (from External Sine-Wave Generator)

Amplitude: Adjustable from approximately 160 to 210 volts.

Driver Requirements: 20 to 50 v rms, 20 to 50,000 cps.

Pulse Output (Externally Generated)

Amplitude: Adjustable from approximately 160 to 210 volts.

Duration (between half-amplitude points): 1.5 μsec to square waves; duration determined by external generator.

Rise and Decay Times (between 10% and 90% of maximum amplitude): Less than 1.5 μsec when driving a load capacitance of 300 pf in shunt with a resistance of 15,000 ohms or less.

Ramp-off: None.

Overshoot: Less than 5%.

Driver Requirements: 20 to 50 volts peak, positive polarity, 20 to 100,000 pulses per second.

Tube Complement: Three 5965, two 5763, one each 6AN8, 6AV5GA, 5651, 5963.

Power Input: 105 to 125 (or 210 to 250) volts, 50 to 1000 cps, 85 watts.

Accessories Supplied: TYPE CAP-22 Three-Wire Power Cord, connector plug.

Recommended Oscillators: TYPE 1361-A (450 to 1050 Mc); TYPES 1215-B (50 to 250 Mc), 1209-B (250 to 920 Mc), 1209-BL (180 to 600 Mc), and 1218-A (900 to 2000 Mc).

Other Accessories Available: TYPE 1264-P1 Adaptor Cable to connect to TYPES 1209-B, 1209-BL, and 1215-B Unit Oscillators; TYPE 1264-P2 Adaptor Cable to connect to TYPE 1218-A Unit Oscillator; TYPE 480-P408 Panel Extensions for relay-rack mounting; TYPE 480-P416 Panel Extensions for rack mounting with the TYPE 1361-A UHF Oscillator.

Dimensions: Width 8, height 7, depth 9¼ inches (205 by 180 by 235 mm).

Net Weight: 12 pounds (5.5 kg).

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OPERATING INSTRUCTIONS

TYPE 1264-A

MODULATING POWER SUPPLY

Form 1264-0100-A
April, 1961

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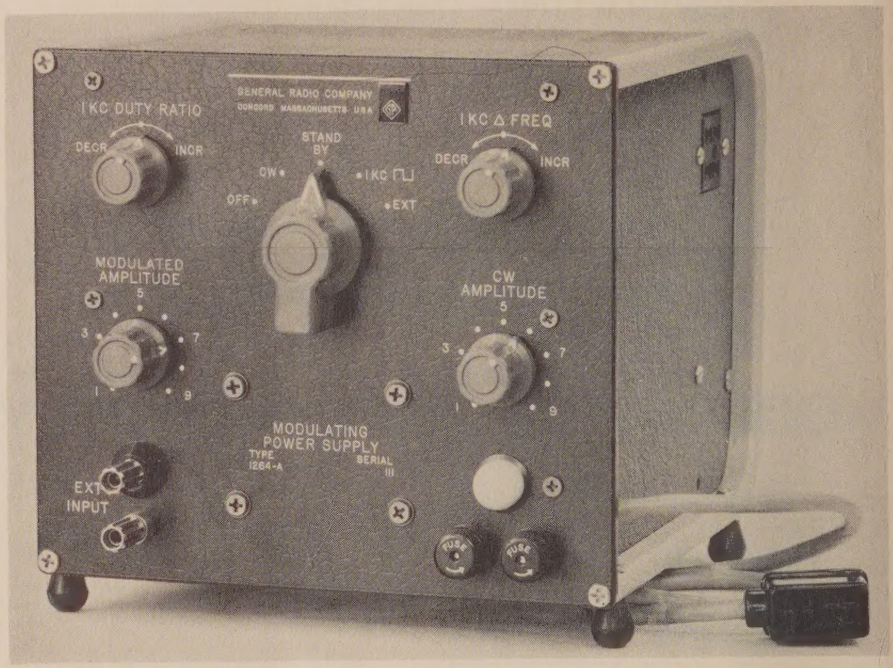


Figure 1. Type 1264-A Modulating Power Supply.

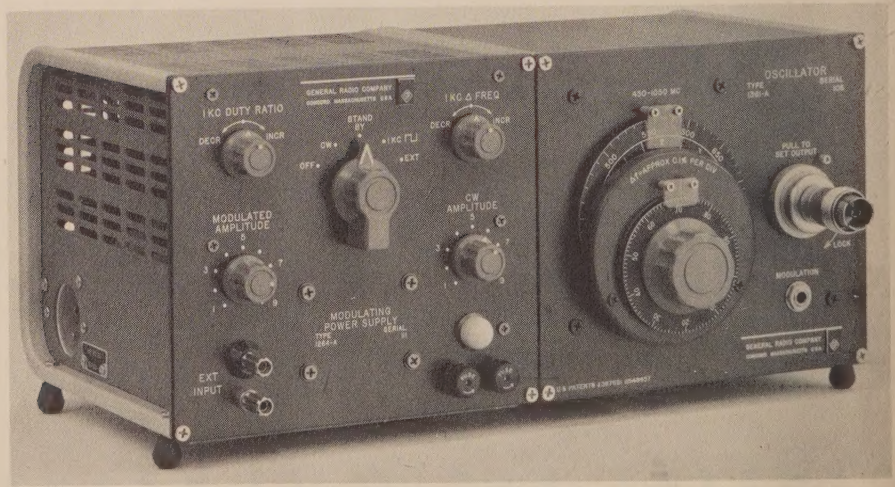


Figure 2. Type 1264-A Attached to Type 1361-A Oscillator.

TYPE 1264-A
MODULATING POWER SUPPLY

Section 1
INTRODUCTION

1.1 PURPOSE.

The Type 1264-A Modulating Power Supply (Figure 1) is designed as a companion instrument to the Type 1361-A Oscillator and similar equipment to permit cw or square-wave-modulated operation of this instrument or pulse-modulated operation using an external pulse source. The Type 1264-A can be bolted directly to the Type 1361-A Oscillator to form a single assembly with all interconnections recessed between the adjacent end frames (see Figure 2). The composite instrument can readily be mounted in a relay rack by means of accessory panel extensions.

With suitable accessory cables, the Type 1264-A can be used with the Type 1209-B, 1209-BL, 1215, or 1218 Unit Oscillator.

1.2 DESCRIPTION.

1.2.1 CONTROLS. The following controls are on the panel of the Type 1264-A Modulating Power Supply:

NAME	TYPE	FUNCTION
1-KC DUTY RATIO	Continuous rotary control	Controls duty ratio of internally generated square waves.
1-KC △ FREQ	Continuous rotary control	Controls frequency of internally generated square waves.
Function Selector	Rotary Selector Switch	Energizes instrument and selects mode of operation.
MODULATED AMPLITUDE	Continuous rotary control	Controls amplitude of square waves and pulses in 1-KC ⊓⊔ and EXT operation.
CW AMPLITUDE	Continuous rotary control	Controls output voltage in CW operation.

1.2.2 CONNECTORS. The following connectors are on the panel and sides of the Type 1264-A Modulating Power Supply:

NAME	TYPE	FUNCTION
115/230 volt 50-400 ~	3-terminal receptacle	Accepts 2- or 3-wire power cable to make connection to power source.
EXT INPUT	Jack-top binding-post pair	Connects external driver for pulse modulation.
	4-terminal receptacle	Accepts power plug from oscillator.
	8-terminal receptacle on end of cable.	Supplies modulation to oscillator.

1.3. ACCESSORIES.

1.3.1 DRIVER. The Type 1264-A Modulating Power Supply when used with a suitable rf oscillator provides cw or 1-kc square-wave modulated output. For other modulation characteristics, an external driver is required. The Type 1217-A Unit Pulser is recommended for general-purpose pulse or square-wave applications. If square waves only are required, the Type 1210-C Unit RC Oscillator may be used as a driver.

1.3.2 ADAPTORS. When the Type 1264-A is used with certain oscillators, adaptor cables are required. These are as follows:

OSCILLATOR	ADAPTOR CABLE
1209-B, 1209-BL, 1215	1264-P1
1218	1264-P2

When an external driver is required, the interconnection may be made by a Type 274-NP Patch Cord.

1.3.3 RELAY-RACK MOUNTING PANEL EXTENSIONS. The Type 1264-A can be relay-rack mounted either separately or together with the Type 1361-A Oscillator. For mounting of the Type 1264-A alone, one pair of Type 480-P408 Panel Extensions is required. For mounting together with the Type 1361-A Oscillator, one pair of Type 480-P416 Panel Extensions is required.

Section 2

INSTALLATION

2.1 GENERAL.

The Type 1264-A Modulating Power Supply is intended primarily for use with vhf or uhf oscillators where square-wave or pulse modulation is desired. Installation requires interconnection with the associated oscillator, and with an external driving source if pulse modulation is required. In certain cases relay-rack mounting, attachment to a companion oscillator, or both may be desired.

2.2 LINE VOLTAGE REQUIREMENTS.

The nameplate adjacent to the power-input receptacle shows the voltage for which the instrument is connected. Instruments are usually supplied wired for 115-volt operation. However, a simple wiring modification at the power transformer primary is all that is required to convert the instrument for 230-volt use. The wiring modification is described on the schematic diagram, Figure 9.

2.3 VENTILATION CONSIDERATIONS.

The Type 1264-A Modulating Power Supply dissipates about 80 watts under maximum load conditions. Most of this heat must be carried away by air circulation over and through the unit. It is recommended that at least one rack unit (1-3/4 inches) of blank panel be provided both above and below the Type 1264-A in permanent rack installations. In bench use, other equipment should not be stacked on top of the Type 1264-A.

2.4 CONNECTIONS TO AUXILIARY EQUIPMENT.

2.4.1 CONNECTIONS TO TYPE 1361-A AND SIMILAR OSCILLATORS. The Type 1264-A Modulating Power Supply can be connected to the Type 1361-A and similar Oscillators directly. The four-terminal connector on the end of the cable from the oscillator should be plugged into the receptacle on the right-hand side of the Type 1264-A, and the eight-terminal

connector on the end of the cable from the Type 1264-A should be mated with the receptacle on the left-hand side of the oscillator after the dummy plug is removed.

2.4.2 CONNECTIONS TO TYPES 1209-B, 1209-BL, and 1215-B UNIT OSCILLATORS. The Type 1264-A Modulating Power Supply can be connected to the Type 1209-B, 1209-BL, or 1215-B Oscillators by means of the Type 1264-P1 Adaptor Cable as shown in Figure 3. The four-terminal connector on the adaptor cable is plugged into the mating receptacle on the Type 1264-A, while the four-terminal connector on the cable from the oscillator is plugged into the mating receptacle on the adaptor cable. The eight-terminal connector on the adaptor cable is mated with the matching plug on the cable from the Type 1264-A. The telephone plug on the adaptor cable is plugged into the oscillator modulation jack.

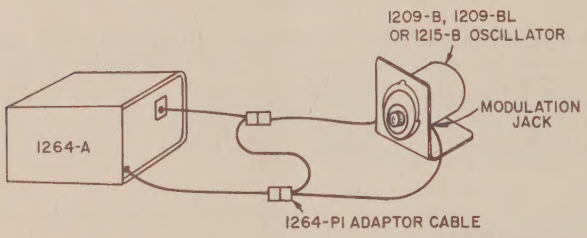


Figure 3. Connection of Type 1264-A to Unit Oscillator by Means of Type 1264-P1 Adaptor Cable.

2.4.3 CONNECTIONS TO TYPE 1218-A UNIT OSCILLATOR. The Type 1264-A Modulating Power Supply can be connected to the Type 1218-A Unit Oscillator by means of the Type 1264-P2 Adaptor Cable as shown in Figure 4. The four-terminal connector on the cable from the oscillator is plugged into the mating receptacle on the right-hand side of the Type 1264-A. The eight-terminal connector on the adaptor cable is plugged into the mating connector on the cable from the Type 1264-A. The telephone plug on the adaptor cable is plugged into the oscillator modulation jack, and the terminal lug is attached to terminal No. 3 on the side of the oscillator. The oscillator function switch should be set to PULSE MOD for best results, although no damage will occur if it is inadvertently set to one of the other positions.

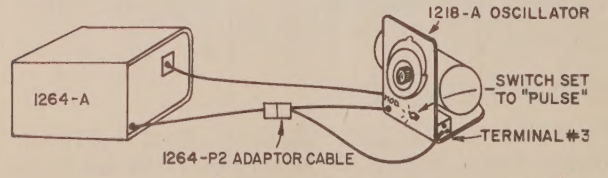


Figure 4. Connection of Type 1264-A to Type 1218-A Unit Oscillator by Means of Type 1264-P2 Adaptor Cable.

2.4.4 CONNECTIONS TO DRIVER. Figure 5 illustrates a typical setup of the Type 1264-A using an external driver (refer to paragraph 1.3.1).

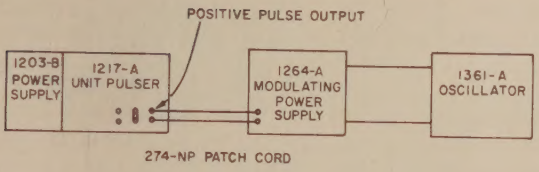


Figure 5. Connections for Pulse Modulation.

2.5 ATTACHMENT TO TYPE 1361-A OSCILLATOR.

The Type 1264-A can be rigidly attached to the Type 1361-A Oscillator by means of four 10-32 screws and bolts (supplied with the Type 1264-A) through four mating holes in the left-hand side panel of the Type 1361-A and in the right-hand side panel of the Type 1264-A Modulating Power Supply. The interconnecting cables are coiled up out of sight between the end frames.

To attach the units to each other, proceed as follows:

a. Remove the dust covers from both instruments by unscrewing the two thumbscrews at the rear of each cover and removing the cover.

b. Remove the rubber feet from the right-hand side of the Type 1264-A and from the left-hand side of the Type 1361-A.

c. Remove the dummy plug from the left-hand side of the Type 1361-A and set the instrument down on its right-hand side, with the panel facing away. Locate the dummy plug as shown in Figure 6a.

d. Place the Type 1264-A down on its left-hand side adjacent to the Type 1361-A as shown in Figure 6a. Coil the cables and mate the matching plugs as shown.

e. Turn the Type 1264-A over so that its right-hand side lies on top of the left-hand side of the Type 1361-A. The cables should now be as shown in Figure 6b.

f. Slip the screws through the mating holes from the oscillator side, and engage the nuts on the power-supply side. It will be necessary to raise the Type 1264-A slightly in order to push the screw near the top front corner home. Then lower the Type 1264-A into place. After all screws and nuts are engaged, line up the panels and end frames of the two units, and secure the screws.

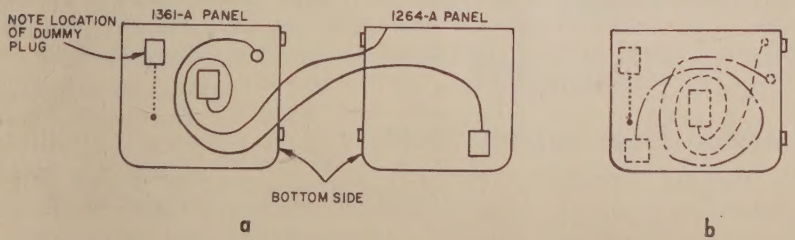


Figure 6a and 6b. Method of Connecting Type 1264-A to Type 1361-A Oscillator. a, above: View looking down on instruments before assembly. b, below: Phantom view showing cable scheme after instruments are attached.

g. Replace the dust covers, making sure that the solid cover is over the Type 1361-A Oscillator and the perforated cover over the Type 1264-A Modulating Power Supply. Be sure that the front edges of the covers slide into the slots on the rear of the front panels; then secure the covers by tightening the thumbscrews at the rear.

2.6 RELAY-RACK MOUNTING.

To mount the Type 1264-A in a relay rack, one pair of Type 480-P408 Adaptor Plates is required. Remove the four screws at the corners of the panel, and use them to secure the adaptor plates to the outside of the panel.

The same procedure is employed to mount the Type 1264-A and the Type 1361-A in a relay rack as one combined unit, except that Type 480-P416 adaptor plates are used.

Section 3

OPERATING PROCEDURE

3.1 PRELIMINARY CONSIDERATIONS.

Before operating the instrument, make sure that the line voltage and frequency are as specified in the nameplate adjacent to the power input connector. Also make sure that the ventilating holes are not obstructed. For details on connecting the Type 1264-A to the Type 1361-A or other oscillators, refer to paragraph 2.4.

3.2 NORMAL OPERATING PROCEDURE.

3.2.1 INITIAL SETTINGS. To apply power to the instrument, turn the function switch (the five-position switch in the upper center of the panel) from OFF to the desired mode of operation.

When the function switch is at STANDBY, only heater voltage is applied to the oscillator. The function switch can therefore be used to cut off rf output from the oscillator while leaving the heaters on.

3.2.3 MAXIMUM OUTPUT SETTINGS. The Type 1264-A will drive the various oscillators close to the maximum allowable output when the CW AMPLITUDE or MODULATED AMPLITUDE control is set fully clockwise. For reduced frequency drift and longer tube life, the AMPLITUDE control should be backed off somewhat from its clockwise limit. For pulsing of the Type 1361-A or 1218-A Oscillator with a duty cycle greater than 0.5, reduce the MODULATED AMPLITUDE setting to prevent excessive tube dissipation.

3.2.3 CW OPERATION. In cw operation the oscillator B+ voltage is adjusted over the range of 200 to 300 volts by means of the CW AMPLITUDE control. Turning this control clockwise increases oscillator output.

3.2.4 1-KC SQUARE-WAVE OPERATION. When the function switch is at 1 KC ⊓⊔, the modulator delivers a negative pulse of approximately 0.5 duty ratio to the cathode of the oscillator. The frequency is adjustable from 850 to 1150 cps by means of the 1KC ⊓⊔ FREQ control. The duty ratio is adjustable over a range of ±5% by means of the 1 KC DUTY RATIO control. The amplitude is adjustable from approximately 160 to 210 volts by means of the MODULATED AMPLITUDE control. The amplitude is entirely independent of the setting of the CW AMPLITUDE control.

3.2.5 EXT OPERATION (PULSE, SQUARE-WAVE, OR SINE-WAVE INPUT). When the function switch is at EXT, the modulator will deliver an output only if a suitable input is applied to the EXT INPUT terminals. This position is most useful when short pulses are required. A positive input pulse of 20-volt peak amplitude is required. Suitable pulses can be obtained from the Type 1217-A Unit Pulser. The video output pulse is of approximately the same duration as the input pulse, but rise and decay times depend on the nature of the load offered by the oscillator. Pulses with duty ratios up to 0.5 (square waves) may be generated without special precautions. The Type 1264-A will accept and deliver pulses of higher duty ratios at all but the highest repetition rates. If a duty ratio greater than 0.5 is used to modulate the Type 1218-A or the Type 1361-A Oscillator, the MODULATED AMPLITUDE control should be backed off in a counterclockwise direction to prevent excessive oscillator tube dissipation. When these oscillators are modulated at a duty ratio of 0.75, the MODULATED AMPLITUDE control should be set at 5 or lower. The Types 1209-B, 1209-BL, and 1215-B Unit Oscillators cannot be overloaded by any setting of the Type 1264-A controls.

Where square waves of approximately 0.5 duty ratio are required at frequencies outside the 850 to 1150-cps internal range, it is possible to generate them in the Type 1264-A by the use of sine waves of at least 20 volts rms applied to the EXT INPUT terminals. The frequency range for such sine-wave drive is 20 cps to 50 kc. Square-wave drive is preferable if the exact duty ratio is important.

3.3 OPERATING INSTRUCTIONS.

3.3.1 GENERAL. The character of the modulated rf output obtained from the various oscillators that can be used with the Type 1264-A depends on

the type of oscillator and the frequency to which it is tuned. The rise and decay times may be either longer or shorter than those of the pulse delivered by the modulator. The characteristics of the modulator when driving a standard load (6000 ohms shunted by 300 pf) are listed in the specifications at the front of this manual.

3.3.2 TYPE 1361-A OSCILLATOR (450-1050 MC). The Type 1361-A Oscillator and the Type 1264-A Modulating Power Supply were designed as companion units, and information on the use of the combination is described in the instruction manual for the Type 1361-A. Satisfactory performance is obtained on both square waves and pulses.

3.3.3 TYPES 1209-B (250-920 MC) AND 1209-BL (180-600 MC) OSCILLATORS. The Types 1209-B and 1209-BL Unit Oscillators can be modulated by the Type 1264-A Modulating Power Supply when interconnected with the Type 1264-P1 Adaptor Cable as described in paragraph 2.4.2. Owing to the presence of filter capacitors and voltage dividers in the oscillators, the amplitude of the pulses output depends on the duty ratio. For maximum settings of both the CW AMPLITUDE and MODULATED AMPLITUDE controls, the peak pulse amplitude is approximately 3 db greater than the cw amplitude for short pulses, decreasing as the duty ratio increases until it is approximately 1 db lower than cw amplitude for square waves. At 500 Mc a typical rise time is 3 μsec and a typical decay time is 4 μsec. Some shortening of the input pulse occurs because of delay in starting of the oscillator. At 500 Mc a 10-μsec-wide input pulse may typically produce a 9-μsec-wide output pulse. At lower frequencies, greater starting delay and appreciable leading-edge jitter may be expected.

3.3.4 TYPE 1215-B (50-250 MC) UNIT OSCILLATOR. The Type 1215-B Unit Oscillator can be modulated by the Type 1264-A Modulating Power Supply when interconnected with the Type 1264-P1 Adaptor Cable as described in paragraph 2.4.2. Square-wave operation is satisfactory over the entire tuning range of the oscillator. Pulse performance is satisfactory from 100-250 Mc for pulses that are not too short. With the MODULATED AMPLITUDE control set fully clockwise (maximum output). the following performance is typical at 100 Mc: rise time 2 μsec; decay time 2-1/2 μsec; for a 10-μsec-wide input pulse, an output-pulse width of 8 μsec. As the frequency is reduced, the performance is degraded until at 50 Mc a starting delay of 12 μsec or more may be expected, accompanied by a rise time of 5 μsec and a decay time of 4 μsec.

The pulse amplitude is independent of duty ratio for the Type 1215-B Unit Oscillator. At maximum settings of the CW AMPLITUDE and MODULATED AMPLITUDE controls, the cw output is approximately 3 db greater than the peak pulse or square-wave amplitude. The CW AMPLITUDE control may be adjusted counterclockwise to equalize the amplitudes if so desired. This adjustment is independent of both the duty ratio and the oscillator frequency.

3.3.5 TYPE 1218-A (900-2000 MC) UNIT OSCILLATOR. The Type 1218-A Unit Oscillator can be modulated by use of the Type 1264-P2 Adaptor Cable

as described in paragraph 2.4.3. Square-wave operation is satisfactory over the entire tuning range of the oscillator, and pulse modulation is satisfactory for most applications. Pulse performance comparable to that described in the Type 1218-A instruction manual may be expected, with appreciable starting delay at some frequencies.

For maximum oscillator tube life, the MODULATED AMPLITUDE control should be backed off when duty ratios of 0.5 or greater are used. At a duty ratio of 0.75, the MODULATED AMPLITUDE control setting should not be greater than 5.

The circuits of the Type 1218-A are such that the ratio of cw to pulse or square-wave amplitude is a function of oscillator frequency. It may not always be possible to reduce the peak pulse amplitude to the cw amplitude.

If the MODULATED AMPLITUDE control setting is increased suddenly, a transient condition of large cw output may occur. This is a normal condition that does not imply instability, and that will not damage the oscillator. This transient will not occur for usual rates of control adjustment.

Section 4

PRINCIPLES OF OPERATION

4.1 GENERAL.

The instrument comprises four basic elements: (1) a highly regulated adjustable dc power supply, (2) a modulator, (3) a Schmitt trigger circuit to drive the modulator, and (4) 1-kc multivibrator to drive the trigger circuit for square-wave output at a frequency determined by the internal generator.

4.2 POWER SUPPLIES.

4.2.1 REGULATED POWER SUPPLY. The regulated power supply uses a full-wave voltage doubler circuit with silicon diode rectifiers and capacitance filtering. R201 limits the peak rectifier current to a safe value. The regulator is of the series losser type, controlled by comparison of a portion of the output voltage with a reference voltage obtained from gas tube V303. The comparison is performed in a differential cathode-coupled amplifier (V304), and the difference is further amplified by V301. The pentode section V301B is cascode connected to V304B of the comparator to provide a high-gain amplifier. Triode V301A is a cathode follower, which couples the output of the cascode amplifier to the grid of the series losser tube V302. The series tube is pentode connected, with a 100-volt screen supply provided by a separate half-wave rectifier and filter.

Adjustment of R402 (in cw operation) or R401 (for modulated operation) varies the proportion of the output applied to the comparison circuit, and thereby controls the output voltage. The output voltage can be controlled over the range from 200 to 300 volts with the function switch (S401) set at CW, and over the range 200 to 250 volts for all other operating positions.

4.2.2 UNREGULATED 1-KC MULTIVIBRATOR POWER SUPPLY. Half of the dc supply voltage that feeds the regulator is used to supply power to the 1-KC MULTIVIBRATOR (V404).

4.2.3 UNREGULATED TRIGGER CIRCUIT POWER SUPPLY. A separate unregulated 300-volt power supply, using silicon diode rectifiers in a voltage doubler circuit with capacitance filtering, provides power to operate the trigger tube (V405). The positive output of this supply is connected to the negative output of the regulated supply. The resulting bus is referred to as COMMON on the schematic diagram (Figure 9). This arrangement permits dc coupling of the trigger to the modulator.

4.2.4 POWER SUPPLY GROUND. The COMMON bus is not internally grounded to the instrument case. Either the COMMON bus or the positive

regulated output bus may be grounded depending on the requirements of the oscillator to be modulated. The necessary grounding is accomplished automatically when the eight-connector cable is plugged into the associated oscillator. This is true whether the connection is direct (as in the case of the Type 1361-A Oscillator) or by way of an adaptor cable (as in the case of the Type 1209-B, 1209-BL, 1215-B or 1218-A Oscillator). The panel of the associated oscillator is also grounded automatically to the case of the Type 1264-A Modulating Power Supply when the units are interconnected.

4.3 MODULATOR.

Tubes V402 and V403 constitute the modulator, which delivers a negative pulse to the cathode of the oscillator, thereby turning the oscillator on. The output pulse amplitude can be adjusted from approximately 160 to 210 volts by means of R401, which controls the supply voltage. In the absence of an input signal, V403 is biased beyond cutoff, and its plate and screen are at the supply potential. When the trigger circuit responds to an incoming signal, the grid of V403 rises to +5 volts, drawing current through R406, and causing heavy plate current to flow through the load provided by the oscillator to be modulated. V401A provides a fixed supply voltage for R406, so that operation of the trigger circuit is unaffected by adjustment of the modulator output amplitude. C402 permits additional screen and plate current to flow briefly while charging the load capacitance, thereby providing a short rise time for the modulating pulse. Tube V402 is inactive during the rise of the pulse, because it is cut off by the bias resulting from V403 plate current flowing through R408. When the input signal ends and V403 is again cut off, V402 conducts and discharges the load capacitance rapidly. This action is enhanced by a pulse of screen current supplied by C401, which was charged up to the supply voltage during the time that V403 was turned on. V401B is diode-connected to permit the screen voltage on V402 to rise above the supply potential until C401 is discharged by the resultant screen current.

4.4 SCHMITT TRIGGER CIRCUIT.

The Schmitt trigger circuit accepts square waves from the internal multivibrator, or pulses, square waves, or sine waves from an external driver, and converts them to suitable waveforms to drive the modulator. V405 is connected as a bistable trigger, with one coupling provided by the common cathode resistor R426, and the other by plate-to-grid coupling resistors R427 (shunted by C406 to provide fast switching) and R428. The plate of V405B is directly coupled to the grid of modulator tube V403, thereby avoiding any tendency for droop in the output pulse even at long pulse durations.

The input bias on the grid of V405A is set by R420 and R421 at a value that ensures triggering by a positive input pulse of 20 volts peak amplitude. Diode CR401 clamps the negative peak of the driving signal on the grid side of C405 to the predetermined bias voltage. This prevents C405 from charging up in such a way as to permit premature cutoff of the

trigger tube V405A under conditions of sine wave, square wave, or long repetitive pulse input signals.

4.5 1-KC MULTIVIBRATOR.

Tube V404 is a conventional ac-coupled multivibrator with the grids returned to B+ through timing resistors R412, R413, R414, and R415. The use of large plate resistors permits thorough bottoming of the tube plates. The output frequency is virtually independent of tube characteristics and of line voltage, even though the supply voltage is unregulated. Output is obtained from the cathode of V404B across R417. The waveform at this point is more nearly square than that at the grid or plate of either tube section. Resistor R413 permits some adjustment of the duty ratio of the square wave, but has negligible effects on frequency, since the time constant of one of the coupling circuits is increased by the same amount as that of the other coupling is decreased. R412 permits adjustment of the square-wave frequency between 850 and 1150 cps by effectively varying the potential to which the timing circuits are returned.

Section 5

SERVICE AND MAINTENANCE

5.1 GENERAL.

The two-year warranty given with every General Radio instrument attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible.

In case of difficulties that cannot be eliminated by the use of these service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest district office (see back cover), requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

5.2 REMOVAL OF COVER.

WARNING

Always disconnect power before opening the instrument case. The total power-supply potential is 725 volts.

To remove the dust cover, loosen the two thumb screws at the center of the rear side of the instrument and withdraw the cover.

5.3 TUBE REPLACEMENT.

Care should be exercised in replacing tubes to be sure that the correct tube type is inserted into each socket. Particular attention is called to the fact that one Type 5963 dual triode is used for the 1-kc multivibrator (V404) at the top center on the modulator circuit board, whereas all other dual triode tubes are Type 5965. Interchange of a 5963 for a 5965, or vice versa, may significantly degrade the performance of the instrument.

5.4 TROUBLE-SHOOTING PROCEDURE.

5.4.1 GENERAL. Since the Type 1264-A Modulating Power Supply is used in conjunction with a separate oscillator, most malfunctions of the Type 1264-A will be manifested in the oscillator output. Conversely, if the oscillator fails for any reason, it will not deliver output even though the Type 1264-A is functioning properly. If no oscillator output is obtained at any setting of the Type 1264-A function switch, determine whether the Type 1264-A or the oscillator is at fault. If another power supply capable of operating the oscillator is available, substitute it for the Type 1264-A. If this is not possible, check voltages and resistances as described in paragraph 5.4.4.

5.4.2 TROUBLE-SHOOTING TABLE. The following table outlines the most common symptoms of trouble, probable cause, and remedy.

Trouble-Shooting Table

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Pilot lamp extinguished.	Line fuse open. Line fuse blown due to short circuit in power supply or load.	Replace fuse. Check capacitors C201, C202, C203, C204, C205 and replace any defective unit. Check associated oscillator for short circuit.
2. No oscillator output with selector in CW position.	No high voltage applied to oscillator.	Check supply voltage across terminals 15 and 16 of SO101. If voltage is correct, trouble is in oscillator or interconnecting cable.

(continued on page 14)

Trouble-Shooting Table (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. No oscillator output with selector in CW position.	No high voltage applied to oscillator.	If no supply voltage, check for voltage at cathode of V302. If cathode voltage is present, S401 is probably defective. If voltage is not present, check voltage at plate of V302. If voltage is present, V302 may be defective or there may be a short circuit across C304 or in the associated oscillator. If there is no voltage at the plate of V302, check R201. If open, look for short-circuited capacitor C202 or C203.
3. Excessive oscillator output, cw or modulated	Excessive high voltage due to failure of regulator circuits.	Check V301, V302, V303 and V304; replace any defective tubes.
4. Oscillator delivers cw output when selector is set to 1 kc ⊓⊔ or EXT.	V403 plate current is not cut off due to failure of trigger circuit. Either tube V405 is defective or the 300-volt unregulated supply has failed.	Check V405 and replace if defective. Check supply voltage for V405 across terminals 12 and 13 of modulator board. If low or missing, check C305. Replace if defective. If not, check voltage across terminals 22 and 23 of rectifier board. If no voltage, check C204 and C205 for shorts; check R202 continuity. Replace any defective parts.
5. No square-wave output from oscillator with selector set to 1 kc ⊓⊔ although output at CW is satisfactory.	Defective tube or defective 300-v unregulated supply.	Check V403 and replace if defective. Check 1 kc ⊓⊔ output at terminal 4 of modulator board. If no output, check V404 and replace if defective. If trouble persists, difficulty is probably covered by (4) above.
6. No pulse output with selector set to EXT.	Input pulse too short due to oscillator starting delay.	Widen input pulse.
	Incorrect drive polarity or amplitude.	Check for positive input pulse of 20 v or greater peak amplitude.

(continued on page 15)

Trouble-Shooting Table (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
7. Square-wave synchronization unsatisfactory with selector set to EXT.	Inadequate input amplitude.	Provide 20-volt peak amplitude square-wave input or 20 rms amplitude sine-wave input.
	Defective tube V405.	Replace V405.
	Defective clamp circuit	Check CR401 and associated resistors R418, R419, R420 and R421.
8. Output occurs with no input drive for selector set to EXT.	Defective V405 clamp circuit.	See (7) above.
9. Poor pulse rise time.	Excessive load capacitance.	Check using standard dummy load. If rise time is satisfactory, trouble is not in modulator.
	Defective V403.	Replace V403.
	Inadequate grid drive to V403.	Check cathode voltage on V401A. If incorrect, replace V401. Check R406 and replace if defective.
10. Poor Pulse Decay time.	Excessive load capacitance	Check using standard dummy load. If decay time is satisfactory, trouble is not in modulator.
	Defective V402.	Replace V402.
	No screen pulse to V402 due to defective clamp tube V401B.	Replace V401.

5.4.3 WAVEFORMS. Those waveforms that are important in the analysis circuit operation are shown in Figure 9. The waveforms shown apply for the 1 kc ⊓⊔ position of the selector. This function provides a check on most aspects of the modulator operation, but rise and decay times on the output pulse are more readily checked with a short pulse (about 5 μsec) applied to the EXT INPUT terminals and the selector set to EXT. Before checking waveforms, connect a standard test load of 6000 ohms shunted by 300 pf across terminals 1 and 7 of SO102. Also connect terminal 3 to terminal 2 and the oscilloscope ground, thereby grounding the "common" bus of the Type 1264-A.

5.4.4 VOLTAGE AND RESISTANCE MEASUREMENTS. Most circuit difficulties in the Type 1264-A Modulating Power Supply will be indicated by improper voltages appearing at various test points. In case of trouble, disconnect the associated oscillator, then apply normal line voltage (115 or 230 v) to the instrument and make the following preliminary checks,

using an accurate vacuum-tube voltmeter having an input impedance of at least 10 megohms.

a. Check that the regulated output voltage with the selector set to CW and CW AMPLITUDE control fully clockwise is 300 volts as measured across terminals 15 (B+) and 16 (B-) of SO101. This voltage can be adjusted by means of R323, a screw-driver adjustment on the rear of the regulator circuit board.

b. Check that the regulated output voltage with the selector set to STD BY can be adjusted to 250 volts by the MODULATED AMPLITUDE control. This measurement may be made between terminals 4 (B+) and 5 (B-) on the regulator circuit board.

c. Check that the unregulated output voltage with the selector set at 1 kc ⊓⊔ is 300 volts as measured between terminals 22 (B-) and 23 (B+) of the rectifier circuit board.

d. Check voltage and resistance against the following table, noting the conditions specified at the end of the table.

TABLE OF VOLTAGES

TUBE (TYPE)	PIN	DC VOLTS TO COMMON	OHMS TO GND
V301 (6AN8)	1	425	0
	2	235	2.1 M
	3	240	430 k
	4	100	900 k
	5	100	900 k
	6	235	2.1 M
	7	250	0
	8	150	72 k
	9	155	33 k
V302 (6AV5GA)	1	240	430 k
	2	100	900 k
	3	250	0
	5	425	0
	7	100	900 k
	8	350	1 k
V303 (5651)	1	85	40 k
	4	0	0
	5	85	40 k
V304 (5965)	1	155	33 k
	2	37	500 k
	3	39	6.8 k
	4	100	900 k
	5	100	900 k
	6	155	33 k
	7	37	51 k
	8	39	6.8 k
	9	100	900 k
V401 (5965)	1	250	300 k
	2	85	510 k
	3	88	∞
	4	150	180 k
	5	150	180 k
	6	250	300 k
	7	250	300 k
	8	250	∞
	9	150	180 k
V402 (5763)	1	250	300 k
	3	130	∞
	4	150	180 k
	5	150	180 k
	6	250	∞
	7	130	∞
	8	120	∞
	9	120	∞
V403 (5763)	1	120	∞
	3	0	0
	4	-60	110 k
	5	-60	110 k
	6	160	310 k
	7	0	0
	8	-20	∞
	9	-20	∞

TABLE OF VOLTAGES (Continued)

TUBE (TYPE)	PIN	DC VOLTS TO COMMON	OHMS TO GND	TUBE (TYPE)	PIN	DC VOLTS TO COMMON	OHMS TO GND
V404 (5963)	1	80	180k	V405 (5963)	1	-50	6.8k
	2	-15	1.1M		2	-190	Note 3
	3	18	18k		3	-190	8k
	4	-60	110k		4	-60	110k
	5	-60	110k		5	-60	110k
	6	75	180k		6	-20	∞
	7	-36	1M		7	-200	95k
	8	0	0		8	-190	8k
	9	-60	110k		9	-60	110k

NOTES

1. For voltage measurements, set function switch to 1 kc ⊓⊔ , MODULATED AMPLITUDE control for 250 v B+, and all other panel controls fully clockwise. Use vacuum-tube voltmeter if available.
2. For resistance measurements, set all panel controls fully counterclockwise, and ground terminals 19 through 23 of rectifier board (1264-70) and terminal 6 of modulator board (1264-72).
3. Resistance at pin 2 of V405 may be 850k or 25k, depending on ohmmeter polarity.
4. Departures of up to 20% from above values should not be considered abnormal.

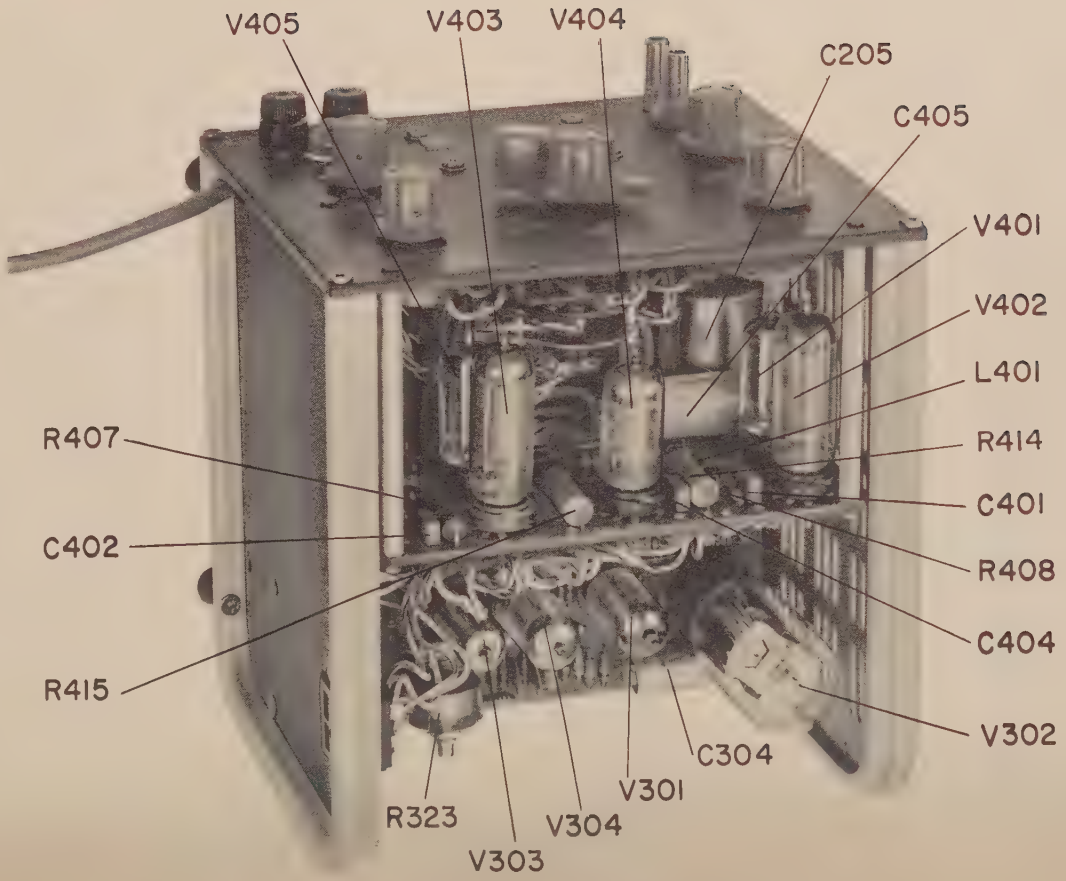


Figure 7. Top Interior View.

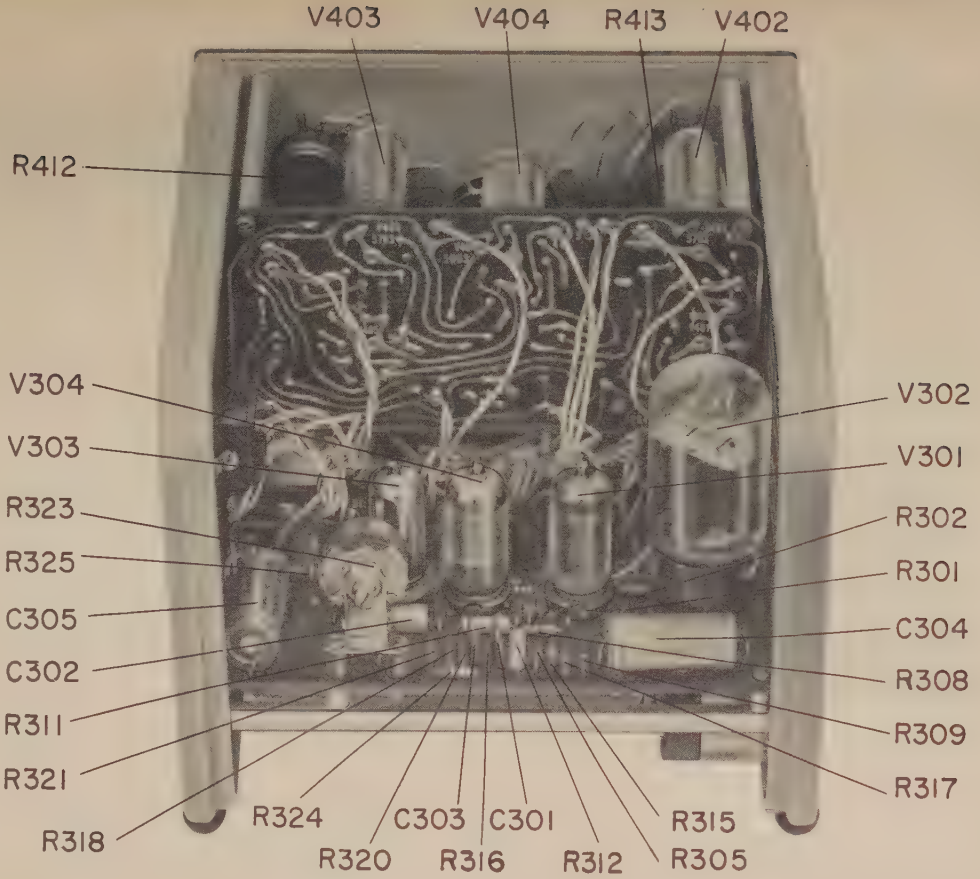


Figure 8. Rear Interior View.

PARTS LIST

RESISTORS

R101	15	±10%	1/2 w	REW-3C (150 C)
R102	1 M	±5%	1/2 w	REC-20BF (105 B)
R201	82	±5%	10 w	REPO-44 (820 B)
R202	47	±5%	1/2 w	REC-20BF (470 B)
R301	10 M	±5%	1/2 w	REC-20BF (106 B)
R302	1 k	±5%	1/2 w	REC-20BF (102 B)
R303	1 k	±5%	1/2 w	REC-20BF (102 B)
R304	2.7 M	±5%	1/2 w	REC-20BF (275 B)
R305	120 k	±5%	1/2 w	REC-20BF (124 B)
R306	100 k	±5%	1/2 w	REC-20BF (104 B)
R307	390 k	±5%	1/2 w	REC-20BF (394 B)
R308	4.3 M	±5%	1/2 w	REC-20BF (435 B)
R309	100 k	±5%	1/2 w	REC-20BF (104 B)
R310	56 k	±5%	1 w	REC-30BF (563 B)
R311	100 k	±1%	1/4 w	REF-65 (104 A)
R312	75 k	±1%	1/4 w	REF-65 (753 A)
R313	1 k	±5%	1/2 w	REC-20BF (102 B)
R314	33 k	±5%	1/2 w	REC-20BF (333 B)
R315	33 k	±5%	1/2 w	REC-20BF (333 B)
R316	6.8 k	±5%	1/2 w	REC-20BF (682 B)
R317	180 k	±5%	1/2 w	REC-20BF (184 B)
R318	2.2 M	±5%	1/2 w	REC-20BF (225 B)
R319	1 k	±5%	1/2 w	REC-20BF (102 B)
R320	1.5 M	±5%	1/2 w	REC-20BF (155 B)
R321	470 k	±5%	1/2 w	REC-20BF (474 B)
R322	200 k	±5%	1/2 w	REC-20BF (204 B)
R323	10 k	±10%		POSC-11 (103 C)
R324	39 k	±5%	1/2 w	REC-20BF (393 B)
R325	3.3 k	±10%	1 w	REC-30BF (332 C)
R401	100 k	±10%		POSC-7 (104 C)
R402	250 k	±10%		POSC-7 (254 C)
R403	120 k	±5%	1/2 w	REC-20BF (124 B)
R404	180 k	±5%	1/2 w	REC-20BF (184 B)
R405	470 k	±5%	1/2 w	REC-20BF (474 B)
R406	12 k	±5%	2 w	REC-41BF (123 B)
R407	10 k	±5%	2 w	REC-41BF (103 B)
R408	330	±5%	1/2 w	REC-20BF (331 B)
R409	240 k	±5%	1/2 w	REC-20BF (244 B)
R410	360 k	±5%	1/2 w	REC-20BF (364 B)
R411	180 k	±5%	1/2 w	REC-20BF (184 B)
R412	250 k	±10%		POSC-7 (254 C)
R413	100 k	±10%		POSC-7 (104 C)
R414	787 k	±1%	1 w	REF-75 (7870 A)
R415	787 k	±1%	1 w	REF-75 (7870 A)
R416	180 k	±5%	1/2 w	REC-20BF (184 B)
R417	18 k	±5%	1/2 w	REC-20BF (183 B)
R418	150 k	±5%	1/2 w	REC-20BF (154 B)
R419	27 k	±5%	1/2 w	REC-20BF (273 B)
R420	5.6 M	±5%	1/2 w	REC-20BF (565 B)
R421	1 M	±5%	1/2 w	REC-20BF (105 B)
R422	100	±5%	1/2 w	REC-20BF (101 B)
R423	150 k	±5%	1/2 w	REC-20BF (154 B)
R424	470 k	±5%	1/2 w	REC-20BF (474 B)
R425	6.8 k	±5%	2 w	REC-41BF (682 B)
R426	4.7 k	±5%	2 w	REC-41BF (472 B)
R427	470 k	±5%	1/2 w	REC-20BF (474 B)
R428	120 k	±5%	1/2 w	REC-20BF (124 B)
R429	100	±5%	1/2 w	REC-20BF (101 B)

CAPACITORS

C201	16 µf		150 dcwv	COE-4
C202	90-30-30 µf		300 dcwv	COE-52
C203	90-30-30 µf		300 dcwv	COE-52
C204	90-30-30 µf		300 dcwv	COE-52
C205	90-30-30 µf		300 dcwv	COE-52
C301	.01 µf	±20%	500 dcwv	COC-62 (103 D)
C302	.047 µf	±10%	400 dcwv	COW-25 (473 C)
C303	.01 µf	±20%	500 dcwv	COC-62 (103 D)
C304	4 µf		450 dcwv	COE-32
C305	4 µf		450 dcwv	COE-32
C401	180 pf	±10%	500 dcwv	COM-22 B (181 C)
C402	.001 µf	±10%	500 dcwv	COM-22 B (102 C)
C403	.001 µf	±1%	500 dcwv	COM-22 F (102 A)
C404	.001 µf	±1%	500 dcwv	COM-22 F (102 A)
C405	0.15 µf	±10%	600 dcwv	COP-25 (154 C)
C406	10 pf	±10%	500 dcwv	COC-21NPO (100 C)

TUBES

V301	6AN8	V304	5965	V403	5763
V302	6AV5GA	V401	5965	V404	5963
V303	5651	V402	5763	V405	5965

MISCELLANEOUS

CR401	DIODE	1N68A
F101	FUSE, 115 v: 0.8 amp 230 v: 0.4 amp	FUF-1
F102	FUSE, 115 v: 0.8 amp 230 v: 0.4 amp	FUF-1
J101	JACK	BP-5
J102	JACK	BP-10, 11/16
L401	INDUCTOR , 100 µh	CHA-3-3
P101	LAMP, 6.3 v No. 44	2LAP-939
PL101	PLUG	CDPP-2-2
RX201	RECTIFIER (200 v PIV)	1N1693
RX202	RECTIFIER (600 v PIV)	1N1492
RX203	RECTIFIER (600 v PIV)	1N1492
RX204	RECTIFIER (400 v PIV)	1N1695
RX205	RECTIFIER (400 v PIV)	1N1695
S401	SWITCH	SWRW-204
S402	SWITCH	SWRW-204
SO101	SOCKET	CDMS-11-4
SO102	SOCKET	1264-40
T201	TRANSFORMER	365-495

NOTES:

All resistances are in ohms, except as otherwise indicated by k (kilohms) or M (megohms).

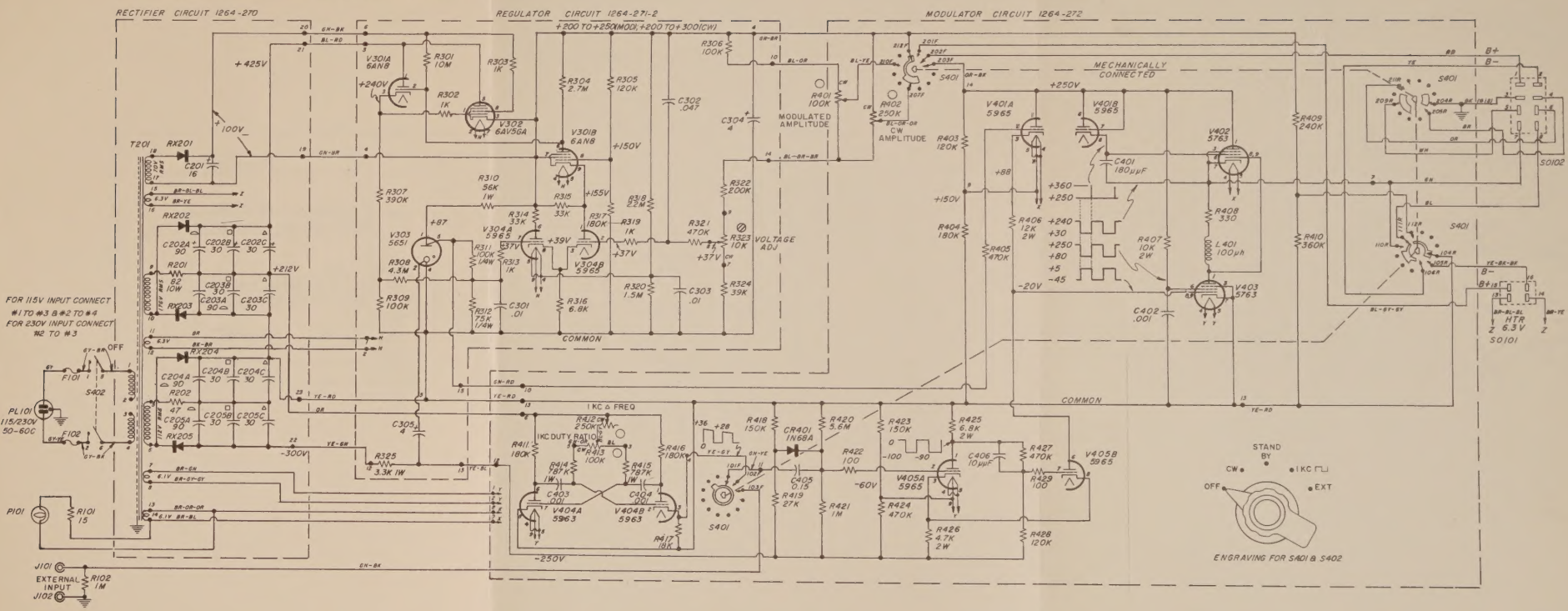
Type designations for resistors and capacitors are as follows:

COC - Capacitor, ceramic
COE - Capacitor, electrolytic
COM - Capacitor, mica
COP - Capacitor, plastic
REC - Resistor, composition
REF - Resistor, film
REPO - Resistor, power
REW - Resistor, wire-wound
POSC - Potentiometer, composition

NOTES:
RESISTORS 1/2 WATT, UNLESS OTHERWISE SPECIFIED
RESISTANCE IN OHMS, UNLESS OTHERWISE SPECIFIED
K = 1000 OHMS M = 1 MEGOHM
CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED
VOLTAGES ARE REFERRED TO COMMON LEAD UNLESS OTHERWISE SPECIFIED
VOLTAGES ARE MEASURED AT 115V INPUT WITH AMPLITUDE CONTROLS SET TO PRODUCE 250V REGULATED SUPPLY VOLTAGE AND WITH S401 SET TO 1 Kc ⊓⊔

⊘ SCREWDRIVER ADJUSTMENT
○ KNOB CONTROL

Figure 9. Schematic Diagram of the Type 1264-A.
(For Elementary Schematic, see next page.)



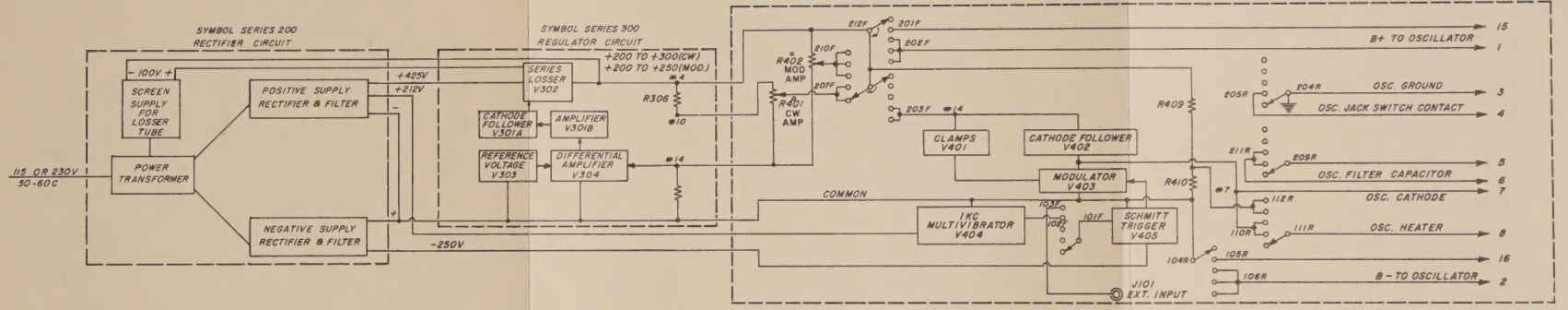


Figure 10. Elementary Schematic Diagram of the Type 1264-A.

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